COMBINING THE TECHNIQUES OF PHYSIOTHERAPY AND BEHAVIOUR MODIFICATION

LYNETTE J. ZEIDLER
Intellectually Retarded Services, South Australia
CHARLES L. ZIMMER-HART
Flinders University

A severely retarded, hemiplegic child who was unable to walk unaided was given a combination of operant conditioning and physiotherapy to teach her the necessary skills for walking. Her progress was assessed daily using operant conditioning equipment and video tape records. The results suggest that behaviour modification offers both viable teaching techniques and methods of objective data collection and evaluation which can contribute to programmes of physiotherapy, occupational therapy, and speech therapy.

In training motor skills in physically and mentally handicapped children, physiotherapists in South Australia have typically based their methods on facilitation techniques (Bobath and Bobath, 1964). Evaluation of progress has generally been by observation of developmental stages achieved and the degree of abnormal patterning in various positions and movement sequences.

Recently techniques based on operant conditioning methodology, typically called behaviour modification, have been shown to be effective in teaching self-help skills to the physically and mentally handicapped. For example, severely retarded children have been taught to walk by rewarding closer and closer approximations to the final skill (Loynd and Barclay, 1970; O'Brien, Azrin and Bugle, 1972; Chandler and Adams, 1972; Westervelt and Luiselli, 1975; LaGanza, 1978; Zimmer-Hart, Warner, Zeidler, Flack and Scott Note 1). These conditioning techniques have also been combined with other therapies. Klonderie (1971) presented a case study in which behaviour modification techniques were combined with physical therapy, occupational therapy, and speech therapy programmes for a cerebral palsied child.

In the following case study, techniques of both behaviour modification and physiotherapy were used to teach a cerebral palsied child to walk. A physiotherapy attendant carried out the training under the supervision of a physiotherapist (L.Z.) and a psychologist (C.Z-H.).

METHOD

Baseline

Tracy, aged 6 years 2 months, was diagnosed as left hemiplegic due to perinatal brain damage, with hypertonia of the left side influencing her arm to a greater degree than her leg. Developmentally Tracy functioned at a 2 year level in cognitive, language, and social behaviours, but was at the 1 year level in motor skills *(Portage Guide to Early Education Checklist;* Shearer, 1976). She was unable to walk unaided, had frequent toilet accidents, was aggressive toward herself (biting her wrist and forearm) and toward others (temper tantrums, occasional biting and scratching).

Tracy could pull to standing on furniture and walk with one hand held. Her typical method of locomotion was hitching in sitting position using her right arm and leg for support. She had poor balance in the all-fours position and was unable to crawl on all fours. In standing the left (hemiplegic) leg was typically held abducted and externally rotated with the knee flexed. In assisted walking this pattern persisted with the left toe being placed down before the heel. The ankle tended to collapse into a valgus position. Head control in standing was impaired, but not sufficiently to prevent independent walking.

Motor patterns were extremely difficult to facilitate due to Tracy's aggressive behaviour and her constant refusal to work in the all-fours and upright kneeling positions. Between her first assessment (14.1.76) and the start of this programme (17.10.77) she had made progress only in standing balance.

Apparatus

Training was carried out in an isolated room devoid of all furniture not necessary for the programme. A teaching machine called the Instructing Radio (IR) was used (Zimmer-Hart, *et al.*, Note 1). This apparatus consisted of a solid state programmer, two large wooden switches, and a cassette tape recorder controlled by the progammer. The teaching machine provided reinforcement (recorded music) for moving between the two switches.

A video camera, tape recorder, and monitor recorded performance during each session and allowed the physiotherapist and/or psychologist

to remotely view the session and comment through a "Bug-in-the-ear" device. Periodic comparison of video records allowed an objective evaluation of improvement in walking skills.

Procedure

Phase 1: Operant conditioning – This consisted of 76 30-minute sessions in which the IR was used to reward better and better approximations to standing and walking. Having established that Tracy's baseline motor behaviour consisted only of pulling to standing, the first stage in training was to teach her to stand beside the table unaided.

This first stage was accomplished by rewarding her for standing beside the teaching machine and pressing the music switch located on the right of the IR. This caused the tape recorder to play for 30 seconds. As is shown in Figure 1-1, the bright orange light next to the switch was left on during the entire session to attract Tracy's attention. This stage ended when Tracy could press the switch at least once per minute without physical prompting.

Next we had to teach Tracy to press the two switches in sequence. A second switch was clamped alongside the IR, the orange light was turned off, and she was now forced to press the new switch to turn on the light and then the music switch to start the tape recorder. Only this sequence was successful. This second stage continued until Tracy could press one switch per minute without physical prompting.

As is shown in Figure 1-3, the second (light) switch was then gradually moved away from the IR, forcing Tracy to walk further and further each time. She was thus forced to master eye-hand co-ordination skills involved in walking sideways around a table.

During stage 4 the light switch was moved to a second table located adjacent to the first. Finally (Figure 1-5) the two tables were moved apart, the distance increasing so long as Tracy continued to make at least one crossing per minute.

Phase 2: Prompting a change in walking pattern – The first phase was terminated when it became clear that Tracy had reached a performance asymptote. The second phase was designed to modify the pattern of walking which had developed.

Observation of video tape records showed that Tracy was unable to balance sufficiently to take an independent step from the starting position she had adopted. This starting position consisted of standing with her back to the music switch while reaching out with her left

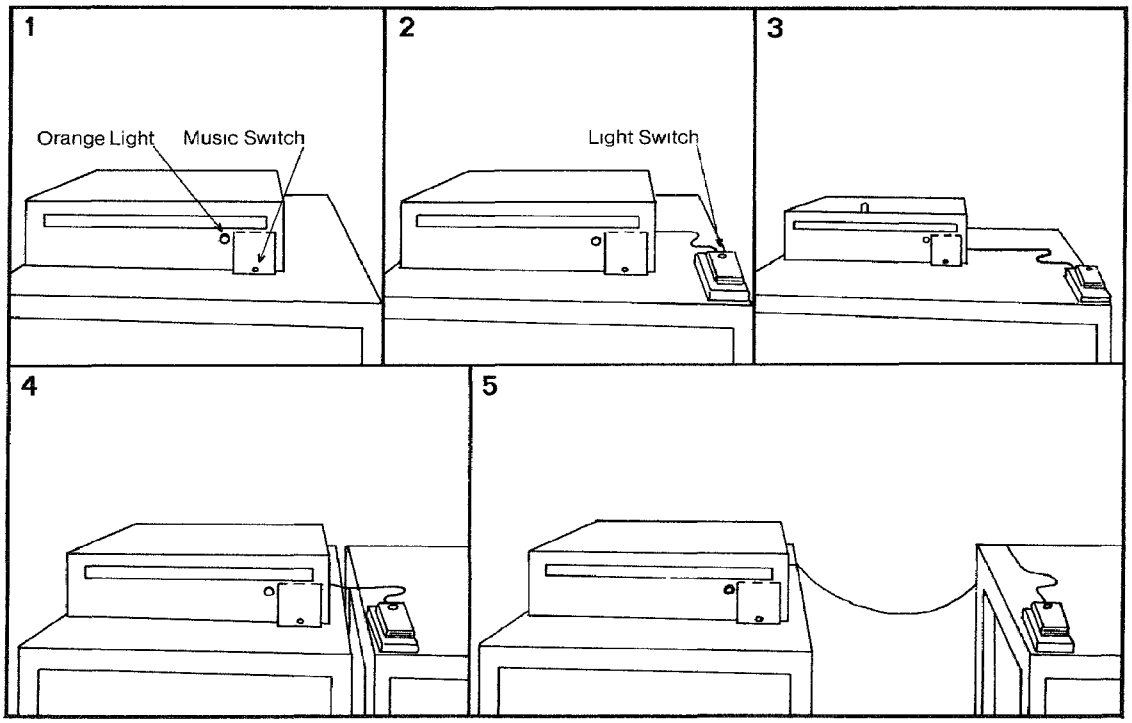

FIGURE 1: THE FIVE STAGE OF TRAINING INVOLVING THE INSTRUCTING RADIO.

(hemiplegic) hand toward the light switch. She became very frustrated with this situation and her temper tantrums and aggression increased, both during training sessions and at home, near the end of phase 1. A method to facilitate weight transfer to her left (hemiplegic) leg to enable her to reach out with her right hand and step forward with her right leg was suggested by the physiotherapist and tried during sessions 76-99.

Phase 3: Shaping walking in a swimming pool – During the second phase the distance between tables remained at about arm span (1 m), but the speed of movement increased considerably. Still, Tracy was unable to take more than a single step and was not "walking". Thus, during the next phase three sessions per week were carried out in the gymnasium and two sessions per week in the heated pool. The gymnasium programme consisted of: 1) facilitation of weight transfer during assisted walking with gradual withdrawal of assistance; and 2) teaching standing from the floor, in which assistance was given to transfer weight to her arm in side sitting while she moved her legs into half-kneeling and then rose to standing.

The programme in the pool was carried out in three stages: 1) building confidence in the water; 2) letting go of the pool side to stand unaided; and 3) walking in the water. The physical education specialist was a consultant during the planning of the pool programme. Verbal praise and singing to Tracy were used to reinforce appropriate behaviour during this phase in which there were a total of 26 sessions. No systematic recording procedure was used during this therapy.

Phase 4: Follow-up operant conditioning – As it was felt at the end of phase 3 that progress was again slowing, it seemed appropriate to test whether the physiotherapy programme had improved Tracy's control of movement between the tables. She thus received several sessions using the IR. During this phase the distance between tables was systematically increased until Tracy took her first independent steps.

Phase 5: Generalization – Once the distance between tables was near 2 metres and Tracy was taking independent steps, a third table was introduced and small pieces of chocolate were used to reinforce her for walking to this table. At the same time singing and verbal priase was used intermittently to reward walking at home and in the training centre. The twice weekly pool sessions were continued to increase the distance walked and to further develop skills of turning, submerging and standing upright, and walking sideways and backwards. Walking around and over obstacles and up and down stairs replaced walking between tables during gymnasium sessions. During this phase Tracy's mother was involved in two sessions weekly and provided liaison with Tracy's school.

RESULTS

The results of this intervention were analyzed graphically and no statistical tests were applied. The changes in behaviour are shown in Figure 2 for phases 1, 2 and 4. Objective records were not taken during the phase in the swimming pool.

During the first phase Tracy learned the switch sequence during session 1, but did not begin to move between tables until session 12. From session 13 to 44 the distance between tables was gradually increased, however after session 45 the improvement in performance slowed. Tracy became increasingly frustrated as the task became harder and harder, throwing temper tantrums both during and outside of the teaching situation. Review of video tape records from the later part of this training (sessions 46-76) showed that Tracy was maintaining balance by leaning against the table near the music switch while reaching out with her left (hemiplegic) hand to close the light switch. Her left leg was placed forward and, because she was unable to transfer her weight onto this leg, she could not step through with her right foot. This analysis led to the re-designed programme carried out in phase 2.

Tracy's aggressive behaviour continued during the second phase and physical assistance to facilitate a change of walking pattern was difficult to apply as she physically fought the teacher. She continued to reach forward with the left hand. The distance between tables was reduced at session 84 and the left arm was held back, however Tracy failed to initiate movement forward with her right side. Training then shifted to the pool.

In phase 3 Tracy soon progressed to independent walking in waist-deep water. In the gymnasium, physical assistance in facilitating a more controlled walking pattern was introduced and then faded out as was the assistance given in standing from the floor. Verbal praise and singing were used as reinforcers for appropriate behaviour only so long as aggressive behaviour or temper tantrums were absent, allowing extinction of temper tantrums.

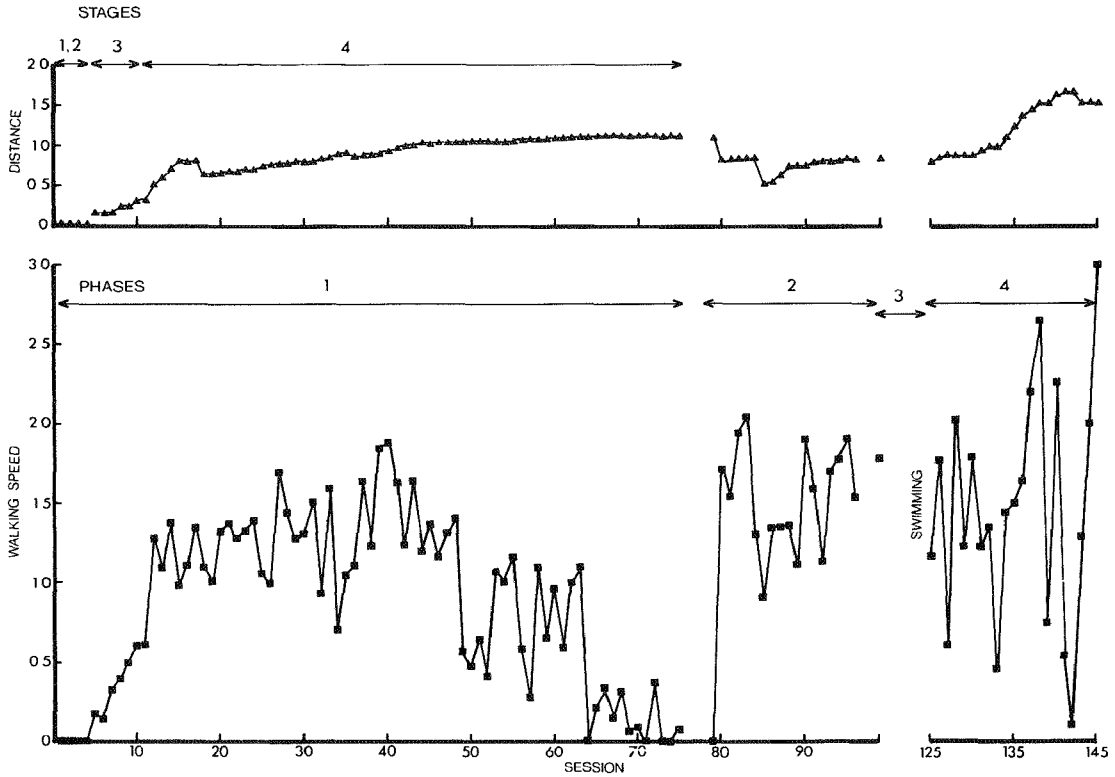

FIGURE 2: TRACY'S PERFORMANCE (shown by daily session in terms of distance between the two tables [in metres] and the rate of walking back and forth between tables [metres crossed per minute]. Sessions 100-125 were carried out in the gymnasium swimming pool an no systematic records were taken. Data for sessions 76-78 and 98 were considered invalid).

When a further objective assessment of performance was carried out during phase 4, the swimming pool programme was proved to be effective in producing a more controlled movement pattern in walking between the tables. The operant conditioning programme with the IR was then continued along with the physiotherapy sessions in the pool. During session 132 Tracy took her first independent steps. Walking then seemed to become intrinsically reinforcing because the rate of progress noticeably increased.

The programme to the stage of independent stepping took five months with a break of one month during the Christmas holidays. Generalization to home and school took approximately six weeks. During this time Tracy also learned to stand from a bean-chair unaided, but it was not until several weeks after completion of the programme that she began standing from the floor unaided.

At present Tracy has considerably fewer toilet accidents and tantrums, probably due to her increased independence. Her parents are now able to take her on family outings. She also went on a camping holiday which would not have been entertained by her parents previously.

DISCUSSION

In a previous study (Zimmer-Hart, *et al.*, Note 1) where behaviour modification was used to teach walking, four severely retarded, cerebral palsied children failed to learn independent stepping, although two other children without cerebral palsy completed the teaching sequence. The results described here are very similar to those of the unsuccessful children in the earlier study during the operant conditioning phase.

Here, however additional intervention with physiotherapy was more successful. Further breakdown of walking into its various components by a task analysis of the movement patterns normally used in walking allowed planning of more specific training procedures for Tracy to learn to transfer her weight and to initiate movement with her non-hemiplegic side. This resulted in her mastering the complete behavioural sequence of walking.

Throughout this case study decisions about training were made by a team, thus basing each decision on several professionals' experience with similar handicapped children. This was possible because detailed video tape records of daily performance were available to be viewed at a time convenient for all team members.

The reason for choosing behaviour modification in phase 1 was a physiotherapy assessment showing little improvement over the prior two years. Decisions to implement change at the end of phases 1 and 2 were made much more quickly because detailed, quantitative information about progress was available.

After phase 3, because of the lack of quantitative evidence of improvement and the need to assess the effectiveness of the physiotherapy programme, operant conditioning with the IR was again introduced and the necessary data for evaluation was collected. The physiotherapy programme was, it turned out, quite effective. Alternative ways of collecting quantitative data with these and other physiotherapy procedures are being investigated at present.

Video tape records give an accurate, unbiased measure of performance which can be viewed by all members of the treatment team as well as parents. As Tracy improved her mother was invited to review the data and join in the teaching programme. She also provided liaison with Tracy's school. This was particularly important in generalizing skills learned at the training centre to the home and school and in consistently extinguishing Tracy's aggressive behaviour.

The benefits of integrating physiotherapy and psychology in perceptual motor training for the moderately and severely retarded cannot be proved in one study, but the evidence from this case together with the results of earlier reports seems persuasive. Operant conditioning methodology provides a system of training and methods for defining progress criteria, data collection and evaluation which make clinical decisions more objective and so clinical success more likely.

Notes

ZIMMER-HART, C.L., WARNER, D., ZEIDLER, L.J., FLACK, M., SCOTT, A.: *A programmed environment to teach severely retarded children to walk.* Unpublished manuscript, available from the Department of Psychology, Flinders University.

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